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The American Biology Teacher

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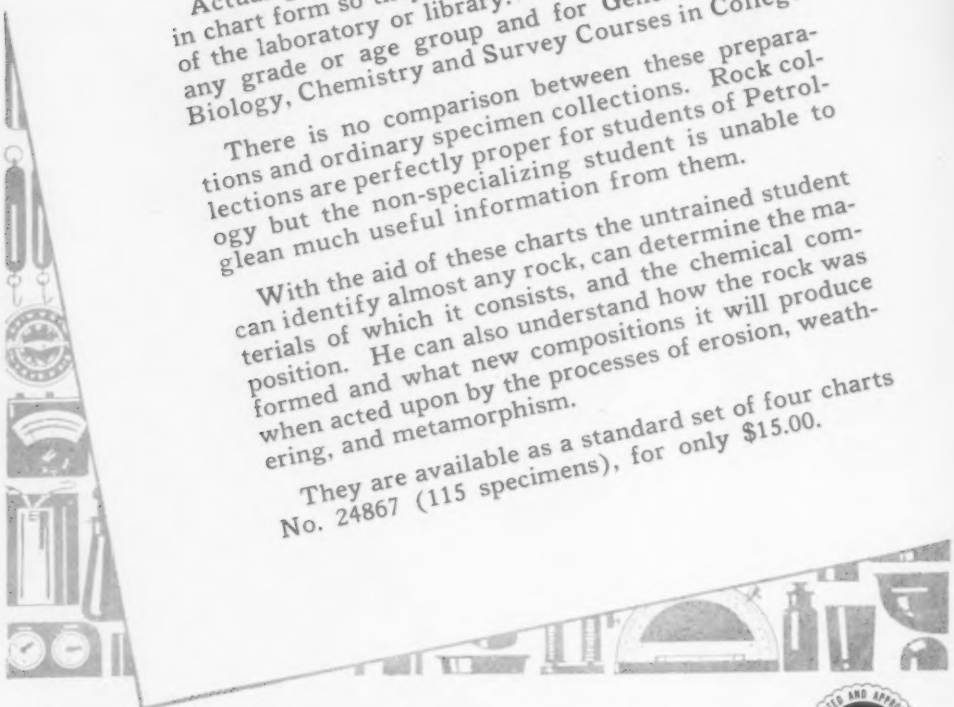

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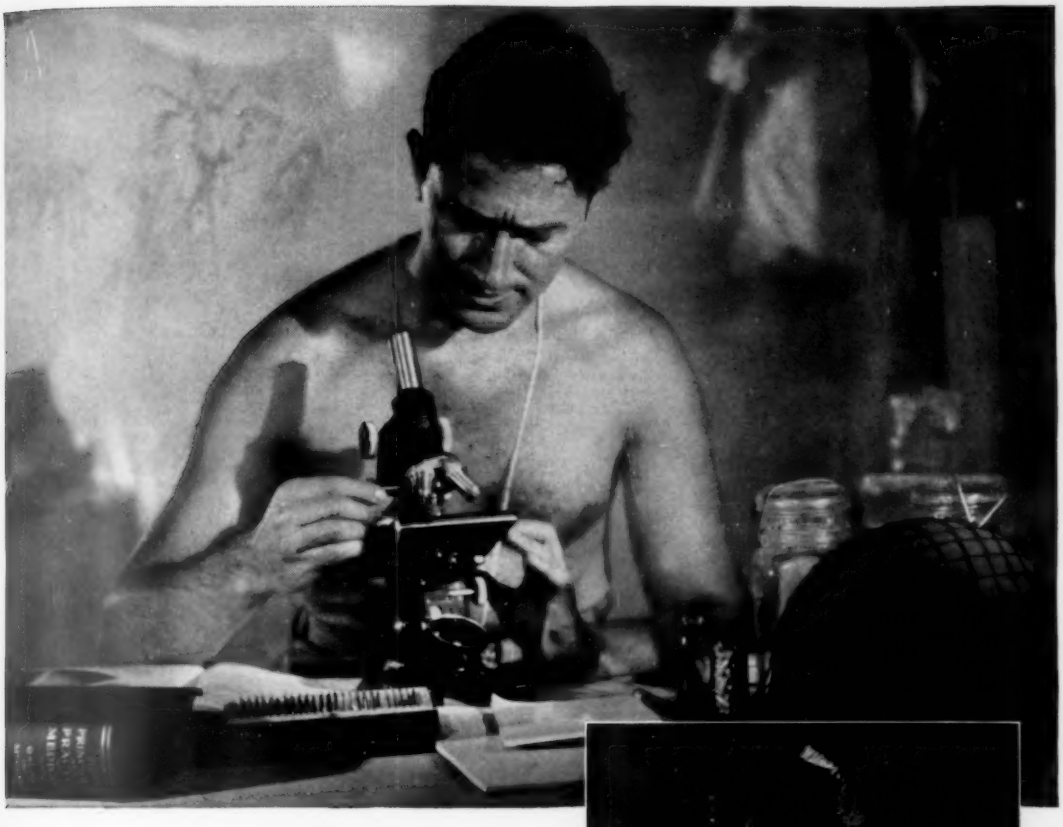

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The American Biology Teacher

Vol. 6 APRIL, 1944 No. 7

Wartime Student Research in Biology

ARTHUR H. BRYAN
Science Department, Baltimore City College*

Never before in the history of our country has research assumed such vital significance. In fact, the outcome of the war will, in all probability, be decided partly in research laboratories in institutions of learning all over our country and those of our fighting Allies. The stimulus to the inquiring mind and research ability might well begin in our high schools where young enthusiastic science students are anxious to take their part in the solution of current war problems. Particularly amongst the higher I.Q. groups, science teachers should stimulate this inquiring tendency.

The key to the successful classroom recitation particularly with the nation at war, is the thought-provoking question usually presented by the teacher. However, in the alert and active high school science classroom or laboratory, thought-provoking questions are just as likely to originate with the student. The class queries of science students may include questions for which there is no positive answer. Such questions may be shoved aside for future reference, consigned to the waste basket, or cast into oblivion. The throwing aside of thought-provoking, pertinent questions does not represent the modern wartime scientific spirit, even in high school science courses. When, therefore, pertinent questions are asked that require some experimentation or original student research to solve, the class may make it a study group problem; however, the course of study will necessarily have to be sufficiently elastic to permit special work. It is the opinion of the writer that science classes can make some attempt to solve problems that are pertinent to the lesson as desirable outcomes.

* The author is now in Military Service, Major V.C., Station Hospital, Fort Eustis, Va.

Cold Light Photosynthesis

Some time ago in a biology classroom, we were discussing photosynthesis, or food manufacture in the leaf. The project for class discussion was to prove that

"the leaf was the world's daylight food factory." Verification by the usual simple class experiments and teacher demonstrations proved that light was essential to the leaf food manufacturing synthetic process. Sunlight and artificial light as sources of energy in this amazing biological manufacturing process were discussed. One keenly alert technical student asked if photosynthesis could take place in the presence of cold light, or phosphorescence only. This question was absolutely unanswerable, but it suggested a fascinating research topic. The students in the early summer months planted some small potted plants and covered them with large bell jars, incorporating dozens of live fireflies. The plants were placed in a dark cupboard and watered regularly.

The experiment excited a lot of interest and opened up a new line of thought. We found, however, that the plants gradually died, in spite of the light supplied by the fireflies; so we supposed, without being certain, that photosynthesis would not take place in the presence of cold light or phosphorescence. This brought up a still more perplexing problem. "What is the source of energy for the manufacturing of food in the red and brown algae located in the dark, abysmal depths of the ocean?" This submarine thought-provoking question is still an unanswered, but nevertheless, our simple experiment may have shed some light on the subject or at least suggested a field for further research and inquiry.

Book Bacteria

A science class was deep in the interesting problems of public health and bacteriology. We were discussing the modes of transmission of disease. One student had a very dirty and grimy book which was evidently ten years old or more, and which must have been in use by successive classes. The student picked up the book, looked at the filthy pages, and asked if there were any infectious or communicable disease germs on the pages. Obviously the teacher could not answer this question directly; so the class decided that an original research investigation was indicated. The student visited schools, libraries, and homes all over the city of Baltimore in order to bring the classroom pages from dirty and old, or over-used books and magazines, etc. The experimental pages were cut to a standard size, $2'' \times 2''$, washed in water, and one cc. of wash water mixed with standard and differential bacterial culture media. The colonies of bacteria which grew out were obviously those washed off from pages of books. This experiment yielded a lot of valuable statistical data, which received recognition in science publications, republications, and abstracts in newspapers, and science magazines all over the country. It was concluded that books were not a serious source of disease transmission except when directly exposed to persons suffering from respiratory droplet infections.

Chalk Dust—Sore Throats

Some years ago, at the old school building, there was an epidemic of sore throats amongst teachers and pupils, which was particularly noticeable during the winter months in classrooms where the ventilation was poor, windows closed and with the black boards used extensively. Sputum samples from students and teachers alike suffering from sore throats were examined microscopically. Many particles of chalk, $CaCO_3$, were found mixed in with the cellular debris. These chalk dust particles undoubtedly were thrown off into the classroom atmosphere when the dusters were used on old black boards and probably set up mechanical throat irritations which broke down the endothelial throat lining thus permitting bacterial invasion.

Antiseptic Mouthwashes

Biology groups studying the hygiene unit, were discussing antiseptic mouthwashes and toothpastes in connection with oral hygiene.

There are many mouthwashes and toothpastes on the market, and ordinarily the only knowledge of their efficacy comes from radio or magazine advertisements. One biology student wanted to know if there was any method of evaluating these preparations. The class, as a project, worked out a system whereby students washed out their mouths with 20 cc. of sterile water for one minute, after which one-tenth cc. of mouth-wash water was transferred by inoculation to neutral agar culture media, while in the liquid state, temperature from 40 to 50° C.

The plates were allowed to incubate for two days, after which the colonies growing out from the mouthwash water were counted, classified, and the pathogens enumerated. Each student participating in the experiment made three wash plates in order to get a mean average of his own bacterial flora.

Afterwards the participating students washed out their mouths with different antiseptic mouthwashes at various time intervals following the gargling. The intervals varied from ten minutes to three hours. Again the wash water was plated, incubated, and the colonies counted and classified.

The critical phase of the experiment followed when the bacterial plates made before and after gargling and toothbrushing were compared. We deduced the fact that the action of mouthwashes was transient, being effective only for a little over an hour in reducing the mouth flora bacteria. The class determined, that frequent toothbrushing with any antiseptic toothpaste effectively reduced the mouth flora of microorganisms. We also noted that cigarette smoking temporarily reduced the number of the mouth floral bacterial, but afterwards there was an apparent numerical increase in mouth germs. Incidentally, we found an unexpected incidence of incipient Vincent's angina cases amongst student groups, suggesting the need for prophylactic treatment, which is significant in military dental hygiene.

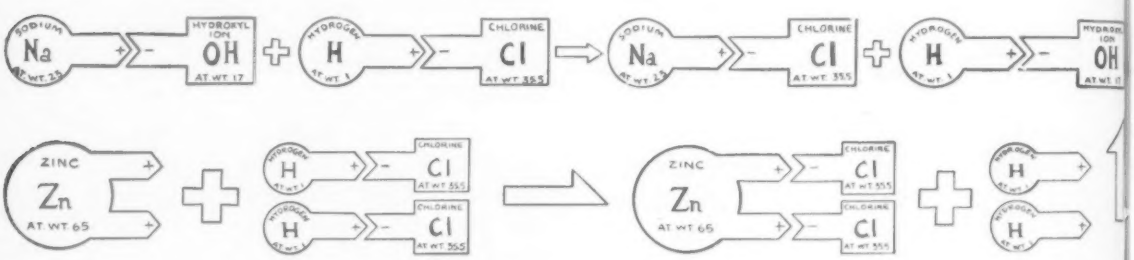
Facial Blemishes

A repulsive, pimply-faced boy started the next experiment by wanting to know why science couldn't do something about clearing up the pimples and acne in adolescent youth. We agreed that facial blemishes had a psychological effect which resulted in social ostracism and tended to develop an inferiority complex in infected individuals. This time we washed the faces of boys suffering from acne and other skin irritations with the usual 20 cc. sterile water, and compiled statistics on the various treatments employed by their physicians in an effort to ameliorate, or cure, the obnoxious condition. We made bacteriological slides and studied pus smears from various acne and pimple formations, in order to find out what kind of bacteria caused them. Positive evidence was secured proving that the new sulfa drugs, in the form of ointments, were therapeutically effective, if the patient soaked his face in hot water first, as a preliminary procedure. Shaving with the safety razor held as lightly as possible and without exerting undue pressure reduced the tendency to pimple formation, especially when an after-shaving alcoholic preparation was used.

Valence Blocks

In the chemistry class, with some blind students present, the teacher was demonstrating simple equations, formulae, and

ionization, involving problems of valence. The blind students were particularly perplexed and unable to comprehend these difficult concepts in chemistry; one of them remarked that if he could only manipulate these elements and radicals he could better formulate equations. Their classmates made the observation that perhaps they could fit model blocks together to make formulas which all could understand. This started a project in which the students made cut-outs in wood or cardboard, representing the elements with their various valences. The models of elements and radicals comprised geometrical figures: circles, squares, triangles and rectangles, of various sizes. The geometrical figures carried a varying number of arms which were used to differentiate positive and negative ionization. The blocks were braille labeled for blind students, and colored red and blue to represent litmus reaction for the seeing students. By fitting these blocks together, we were able to construct formulas and equations, including even some simple organic formulas. These blocks were labeled, perfected, and patented; and are on the market today as a device for teaching the fundamentals of chemistry. These blocks are finding their way into training schools in the Army chemical warfare service where enlisted personnel are taught through short practical courses the fundamentals of chemistry.



Use of valence blocks to show how hydrochloric acid reacts with sodium hydroxide and with zinc. Illustration by courtesy of Chicago Apparatus Company, from whom sets of the *Bryan Valence Blocks* may be obtained.

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Growth-Regulating Substances in Plants

SISTER MARY DE LOURDES, B.V.M.
Saint Mary's High School, Chicago, Illinois

Modern science is acquainted with about fifty substances which will regulate growth. Some of these accelerate growth, some retard it, while some initiate the formation of organs, or produce abnormalities. This paper will be concerned with chemicals that are easily secured commercially, have been tested rather rigidly, so that their results can be predicted, and their effects be produced with a certain measure of promptness. I shall not attempt to describe them as "vitamins" or "hormones," as these terms have not been precisely defined. It is not within the scope of this paper to go into the exact physiological action of these substances. They will be described in terms of final results.

Found to be most useful in promoting plant growth are several weak acids, *indoleacetic*, *indolebutyric*, *indolepropionic*, *naphthaleneacetic*, and *phenylacetic acids*, and *naphthalene acetamide*. Extremely important is the *vitamin B* complex. *Colchicine* also may be mentioned.

The *auxins* were the first of the growth regulators to be identified. This name "auxin" has been applied to the whole group of growth-regulating substances although it might better be limited to auxin a (auxentriodic acid) and auxin b (auxenalonic acid) produced by the higher plants, and heteroauxin (indoleacetic acid) produced by bacteria and molds in metabolism. The effects produced by the auxins are somewhat similar. Heteroauxin was found to be the most active, and it is its synthetic equivalent, indoleacetic acid, which is available commercially.

Indoleacetic acid when applied externally initiates the formation of roots, causes cell elongation and general growth, forms lateral roots, and lessens the tendency to bend—"a tropism."

Indolebutyric acid induces rooting of cuttings and considerably shortens the time required to form these roots. It is also used in seed treatment, and spraying of foliage to promote acceleration of growth.

For those interested on a larger scale in gardening and farming, *naphthalene acetic acid* will serve as a "stop and go" chemical to halt blooming of orchards, prevent winter potatoes from sprouting, cause fruit to set without pollination, prevent premature dropping of apples, and make seeds lie dormant or send out sprouts.

Naphthalene acetamide has speeded up root formation, induced growth of seedless fruits, caused stems to grow stiff and woody, and restrained flower buds from opening until danger from frost was past.

Vitamin B gives a general acceleration of plant growth. It is especially effective in rooting of cuttings, transplanting of woody plants, reinvigorating sick and straggly plants, and in producing larger and healthier plants.

Colchicine is not classed as a hormone but it has played a part in plant genetics. All the other chemicals act on the cyto-

plasm to increase or inhibit growth, whereas colchicine acts on the chromosomes, inducing the doubling of the number of chromosomes in cells, a condition referred to as *polyploidy*. This doubling induces mutations and produces bigger and brighter flowers in many of our common garden varieties such as marigolds, snapdragons, zinnias, and the like.

Colchicine when applied to induce polyploidy is confined mostly to vegetative growing points and may be used in the treatment of seeds, seedlings, growing shoots and buds, bulbs and corms. The seeds and seedlings are totally immersed in a weak solution of colchicine; shoots and buds are treated by brushing or placing a drop or two of the solution over the exposed tips; bulbs and corms have the colchicine introduced into the growing regions by a hypodermic needle. Because of the poisonous nature of colchicine, great care must be taken in its use. In fact, the manufacturer's directions should be studied carefully for *all the chemicals used in plant growth*.

These chemicals may be used in the following ways:

1. By applying the regulator as a fluid to the soil.
2. By rubbing it as a salve on the stem for root stimulation.
3. By spraying it as an emulsion on the leaves.
4. By soaking seeds, leaves, stems, or roots in the chemical.

A method particularly useful for treating greenhouse plants consists of fumigating the house by vaporizing the powder.

The substances used to regulate growth may be obtained from chemical-supply houses or from your pharmacist. Turtox and other biological supply houses offer them in various forms for school use. The UNITED STATES DEPARTMENT OF AGRICULTURE in its publication on *Plant-Growth Regulators* gives a detailed account of how to prepare and apply these substances. Although the bulletin specializes in the rooting of cuttings and methods of treating them, there are many classroom experiments that are interesting and show amazing results.

Cuttings for school gardens need only to be dipped into the root-forming substance before planting, and by means of untreated specimens a comparison of results can be made on the speeding up of roots. Greenhouses are using this routinely.

Roots can be induced to grow on soft green stems of begonia, coleus, and Christmas cactus by applying a salve containing a root-forming hormone, as a ring around the stem and close to a node. The cut is made just below the ring in about two or three weeks, when roots have probably appeared and then the cutting is placed in another pot to continue growth.

Bulbs have reacted to hormone treatment by shortening the blossoming time as well as by increasing the size of the blooms. A set-up of test and control bulbs makes an effective experiment.

Seed germination is another suitable experiment. The seeds are dusted with a hormone powder and the time for germination is carefully watched and compared with that of untreated seeds, to see the effect of chemicals on hastening germination.

With the intense interest of Victory Gardens now in vogue, the results of school experiments may be taken to the community garden or farm. Some may be interested enough to plant sections with treated seed and others with untreated seeds or cuttings.

Different commercial growth-promoting substances may be used to determine the relative merits of each. Vitamin B

(Continued on page 168)

Weedy shoals provide cover for spawning and furnish the feeding areas for fish. Photo by Indiana Department of Conservation.

Conservation Series, Unit III

Conservation of Fishes

HOWARD H. MICHAUD
North Side High School, Fort Wayne, Indiana

Good Fishing

Good fishing, both present and future, depends upon good conservation. Wasted water and its accompanying loss of fisheries resources is too frequently interpreted as "water over the dam." Fortunately, it is possible to establish a constructive program of fish conservation in our lakes and streams.

It is of primary importance to realize that fish conservation must be integrated with all other worthwhile conservation practices. *Aquiculture* like agriculture depends upon improvement and proper management. To whatever extent is possible, the control of environment becomes an important factor in all wildlife management. Poor fish production is quite apparent in waters drained from poor agricultural land, compared to waters receiving drainage from rich farm lands. The same basic nutrients are needed by both land and water life.

The productive capacity of some inland water areas has been considerably reduced by man. Clearing of land and specific drainage projects have been partly responsible. In areas where forest cover has been removed, streams become much lower during summer drought, and the smaller streams dry up completely. The dredging and straightening of stream channels is even

more destructive. The stream flow is reduced and because of its even bottom, very few desirable fish are produced.

Natural lakes too are seriously affected by drainage. In many places shallow lakes have completely disappeared, while others have been considerably reduced in area by excavation of their outlets. More damage is done in other respects than is proportionate to a reduction of area. The littoral area of a lake is most productive. Where lake levels are lowered several feet it is this shallow region nearest to the shore line which is most affected. The shallow zone will be much more limited because the steep drop off will be nearer the new shore line.

Stream banks and pond edges which are vegetated to hold against excessive sloughing and erosion are beneficial to maximum production within a body of water. Turbidity is thus reduced, giving greater production of water plants, fish and other aquatic life. The principle of interrelationship is broadened extensively because of the resultant benefit to wildlife. Stream banks covered with a mantle of luxuriant vegetation offer to wildlife, as the raccoon, excellent cover, abundant food and clean water. Wildlife is estimated to be present in numbers roughly proportional to the length of shore line. Adequate protection to preserve the water border vegetation has become one of the most important management considerations, especially on farm ponds and artificial bodies of water.

It is obvious that fish production may be expanded by increasing available water areas. Numerous ponds and lakes have been created in the name of flood control—reservoirs to store water and control excessive run off. Small farm ponds are built to supply ample storage of water for stock. Abandoned quarries, gravel pits and strip coal mine pits are bodies of water which appear as an incidental result of commercial enterprise. Large lakes have been produced by damming streams to provide hydro-electric power. Municipal water supplies are frequently maintained in the form of artificial lakes.

The worst enemy of artificial water areas is sediment. The life span of impounded waters in inversely proportional to the sediment deposit of the feeder streams. When these streams flow through land without a protective cover of vegetation, sediment fills the reservoir in a few decades.

Problems of Fish Production

The basic producers in the water, as on the land, are the water plants—from the larger "water weeds" to the smallest algae. Like farm crops, certain water plants seem to be more desirable in producing fish crops. However, it is less practical to attempt control of plants in water, as is done on the farm.

In addition to their value in producing basic food, plants are beneficial to fish in many other ways. Larger plants reduce wave action and help to hold the bottom. This provides greater security for spawning and supplies a richer bottom for insect food production. Plant life increases the surface upon which food organisms may grow. Decaying plants add fertilizing materials to the bottom, thereby stimulating the source of food. Northern pike, many minnows and perch at times lay their eggs directly over the vegetation, which helps keep them free from soft silt. Generally, lakes with a well-balanced quantity of vegetation furnish better fishing.

The most valuable consideration of plant life in a body of water is its contribution as a source of food. While the majority of fishes are recognized as carnivorous in their food habits, there are a number of species known to feed directly on plants. The gizzard shad consumes

the minute, often microscopic plant and animal life in the water. The stoneroller minnow and other members of the Family Cyprinidae are vegetarians to a considerable extent. Other fishes like bluegills may feed on a certain quantity of green water plants and the rainbow trout depends upon algae for a part of its regular diet.

Our most desirable game fishes, however, feed on small insects, their larvae, crustaceans and fish. Since most of these smaller organisms feed on plants, fishes are indirectly dependent upon vegetation. A complex food chain of this sort means a loss of energy and nutrient material with each turnover. The most ideal production is naturally obtained using fish which, for the most part, consume plants directly. The various suckers, buffalofish and carps are examples which, to a considerable extent, feed directly on vegetation.

The use of such fish, removing them systematically when grown, produces a maximum crop comparable to beef and pork on farms of equal fertility. This practice has long been recognized in Europe, where fish crop culture carried on extensively can be made to offer about the same returns as regular farming. Frequently the same land is used for both; after a large shallow pond has been used for fish culture for several years, it is drained and planted to agricultural crops.

Since our demand is great for sport fish, and they subsist primarily upon animal food, we must be content with smaller yields because the longer food chain means smaller production. If the food chain is further extended we can expect diminished returns. Consequently, insect eaters like bluegills will furnish greater production than fish eaters like bass.

The food relation of fish production, like agricultural stock husbandry, depends upon two basic principles: (1) *The number of fish maintained must be adjusted to the water carrying capacity.* If too many fish are present, the water is overstocked and produces less than its potential yield, so fish are smaller and are not in good condition. If there are not enough fish present some of the available food is wasted. (2) In the case of greatest production of beef on a farm, young animals must be used, killing them before they have reached maximum size. Similarly, *fish should be taken soon after they are large enough to be useful to man,* leaving as many large ones as are needed for breeding stock.

Regulating fish populations is not so simple as maintaining farm stock. One criterion however, can be applied—the rate of growth. Investigations have shown that too rapid growth or too slow growth results in inefficient utilization of food. Abundance of fish should be adjusted to the point of intermediate growth for maximum production.

While maintenance of a proper balance of food in waters is of primary importance, there are other essential factors which are necessary to meet fish requirements. Chief among these are: 1. *Temperature,* 2. *Sufficient quantity of dissolved oxygen,* 3. *Depth,* 4. *Favorable spawning conditions,* 5. *Shelter,* 6. *Protection against disease and excessive predation or competition,* 7. *Freedom from pollution and extreme turbidity.*

1. THE TEMPERATURE consideration varies according to species. Cold-water types include trout, whitefish and ciscoes. Northern pike and perch are found in warmer waters, but do not usually survive in lakes and streams further south than northern Indiana. Largemouth bass, crappies, most sunfishes and some of the catfishes are warm water forms.

As a rule among plants and cold-blooded animals an increase in the temperature of the environment tends to accelerate life processes. Warmer water, therefore, for fishes that are able to tolerate higher temperatures, ordinarily contributes to greater fish production. No specific rules can be established,

owing to the various tolerance of different species and to other factors such as the amount of impurities and oxygen content of the water.

2. THE QUANTITY OF OXYGEN dissolved in water even under conditions of complete saturation is minute. When completely saturated water contains by weight approximately 7 to 15 parts per million, varying with the temperature of the water. Fishes generally do not require oxygen in amounts which are near 100% saturation. Under normal conditions 50 to 75% saturation is seemingly sufficient to prevent mortality. Less than 50%, or 4 parts per million is usually regarded as alarming.

Since respiration is reduced in cold weather, fish can live with less oxygen when the water is cold than when it is warm. As with other variable conditions the quantity of necessary oxygen varies with species. Trout succumb in water containing enough oxygen for bullheads. Fry may die because of oxygen deficiency in water which may be suitable for adult fish. Spawning beds require a high content of dissolved oxygen.

3. SUITABLE DEPTH, particularly in a large lake of 500 acres or more, holds an important relation to its fish carrying capacity. In such a lake an average depth of 10 to 20 feet plus an irregular shore line is better than a lake of much greater depth. Shallow lakes, if not too shallow, furnish more abundant food, greater weed beds for shelter and favorable spawning grounds. If a large lake is too shallow, fish are not afforded sufficient protection against wave action, intolerable variations in temperature, sudden changes in water level, predation and oxygen deficiency under ice in winter.

Conditions of suitable depth for large lakes do not necessarily hold for smaller bodies of water. There are numerous small lakes and ponds under 25 feet in average depth that do not experience these difficulties.

4. UNLESS ARTIFICIAL PROPAGATION is to be relied upon, spawning conditions must be adequate to insure a sufficient hatch to yield a given number of adults. Spawning beds must be protected against water which is too shallow to prevent drying of eggs and fry. A relatively high oxygen content and proper temperatures for the specific type of fish concerned are important. Silting from erosion, water currents, motor boats or other disturbances are harmful to fish eggs. Protection during the height of spawning needs to be determined for the species. Some northern lakes for example, seldom become warm enough (about 68° F.) on the shoals for bluegills to spawn. The dates for spawning will vary from year to year depending upon the season's temperature. The time for protection varies tremendously with states, because of latitude.

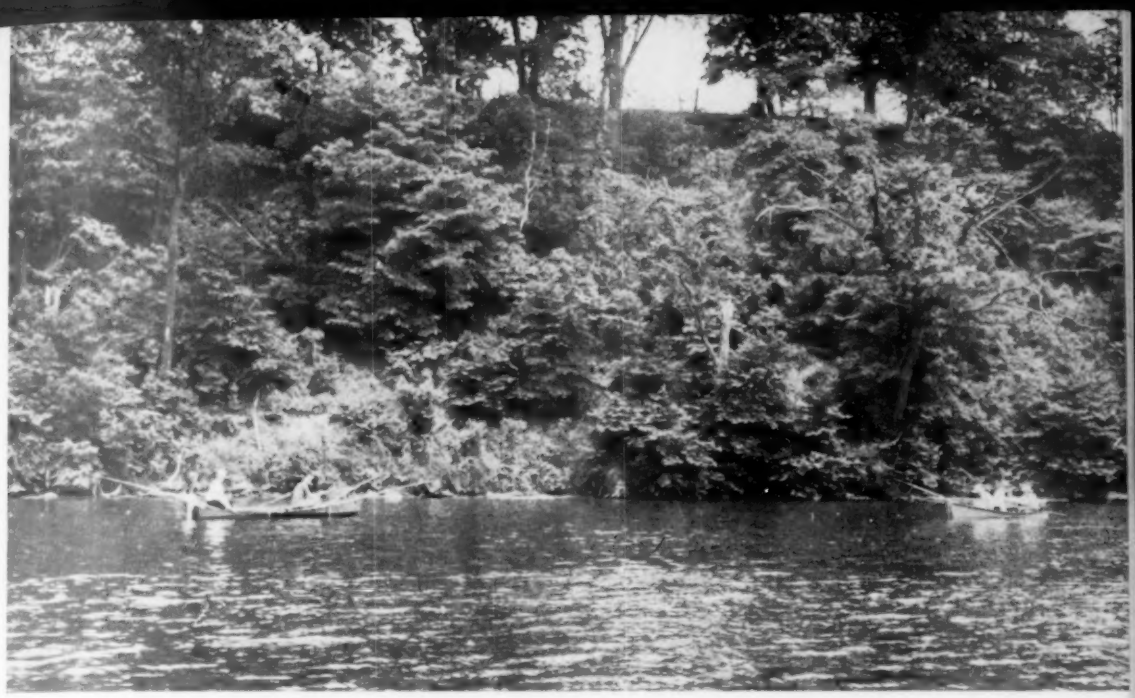
5. VEGETATION, which has previously been mentioned as a food producing agency, also forms the chief natural cover for fish from fry to adult. Short thick bottom growths have particular value as hiding places for newly hatched fish. Floating leaves, rushes and sedges with emergent leaves, or overhanging grasses along streams will furnish beneficial cover. Underwater brush, logs, stumps and boards often prove effective types of shelter. Boulders, rock slabs, overhanging ledges and bottom irregularities provide hiding places of value for many species. The deep holes in a stream are valuable as places of retreat and rest for particularly the larger fish.

A good fishing stream will have alternating pools and riffles, interspersed at frequent intervals. The riffles, which are well lighted and aerated as they flow over stones, support a wealth of food for fish. The larger fish venture out of their deeper places of hiding to forage for minnows, darters and other organisms which are abundant in the riffles. A well-balanced stream with many feeding places near sufficient cover will generally support more fish than one which falls short of this combination.

6. DISEASE CONTROL among fishes in natural waters on the basis of present knowledge is quite impracticable. Since little progress has been made along these lines, it is fortunate that disease epidemics are not common in nature. That they may occur, however, was recently emphasized by the disastrous epidemic which has temporarily wiped out the lake Michigan smelt as a commercial fish. Stock planted from hatcheries should be healthy and free from disease. Since some diseases of fish are specific, affecting only one or several kinds of fish, it has been found desirable to build up a stock of several species so that an epidemic affecting one species may not destroy the entire fish population.

Predators are popularly defined as undesirable species, like the bowfin and gar, which prey upon other fishes. On the other hand, some of the desirable species as the pike, crappies and perch are likewise predaceous or even cannibalistic. In fact, the majority of fresh water fishes are carnivorous.

Control measures of the past have often involved removal of these undesirable kinds. However, the destruction of predators has at times produced unfavorable results. If for example, a population or bass or bluegills in a lake should tend to become over populated, predators may help to adjust this condition. The basis for removal of predators is a highly technical problem since there are many biological considerations which need to be taken into account.



Steep banks of lakes and streams need sufficient vegetative cover to prevent erosion and silting. Photo by Indiana Department of Conservation.

7. Pollution. Separately treated, see page 159.

How Much Fishing?

How much fishing can local waters stand? If big fish are less frequently caught, does it mean that a body of water is not producing at maximum efficiency? Are fishermen familiar with the fish production of nearby waters, the numbers of legal fish and the proportion being caught? What is the mortality rate of legal fish? The value of such information in wartime needs no emphasis, since wartime demands offer special inducement to do more fishing for food.

Increased fishing may have several effects on fish populations. The breeding stock may become so reduced that it may not yield an ample supply of young by natural reproduction. This condition is popularly called "over exploitation." Increased protection for adult breeding fish frequently has been established on the basis of this fear of "over exploitation." Federal and state fish hatcheries have been called upon to supply the young fish presumed to have been lost by the taking of adult spawners.

Recent investigations indicate that the amount of fishing which should be done depends upon the *balance* of growth rate and natural mortality rate. Where a fish population increases in weight, each year, at a rate which is greater than its annual mortality rate, fishing should be decreased, or the size limit should be increased. Thus the annual growth rate and natural mortality rate will tend to become more nearly balanced. From the standpoint of a fish harvest, a greater total poundage will result. It will pay to let the little ones grow bigger, if they can gain in average weight more than they lose in numbers. However, if natural mortality exceeds the rate of growth, it will pay to catch smaller fish where a maximum poundage of harvest is desired, providing there are always enough spawners left for adequate reproduction.

It is a popular notion that too much fishing is responsible for the loss in fisheries resources. The propagation and stocking of fry and fingerlings is based partly upon this popular assumption. However, scientific investigations indicate that in some cases, especially among the warm water sport fishes, "under exploitation" is sometimes the cause of poor fishing.

Good fishing should not be confused with a good total production of fish. If a fish population has not been subjected to fishing pressure the larger fish tend to accumulate and form a rather large part of the population. When such waters are first fished, naturally the fishing is

reported as wonderful. Under increased fishing pressure the mortality rate of these adult fish is greatly accelerated and the abundance of the larger fish falls off rapidly even though this may be fully compensated by an increased rate of growth of small fish. In this manner the total poundage production may be greater while the catch per day's fishing is reported as poorer.

Over fishing results when the annual catch exceeds the annual production of fish in a body of water. The best rate of fishing, for sport fishes, should coincide with *maintenance of maximum production*. This aim should not be pursued beyond the point at which the fish would be too small. Because the amount of fishing can affect both the size and abundance of fish, information concerning these effects must be obtained from typical waters. The problem of fishing in relation to over exploitation should be correlated with the maintenance of a maximum yield of fish crops. Efficient harvesting of fish is based on removal of fish which have passed their age of rapid growth. The cropping of fish should be proportionate to the capacity of fish production in a body of water. It is of the same importance as yield per acre on a farm rather than the number of acres. Conclusions must be based, moreover, on adequate statistical data by skilled investigators who have the means at hand to determine the rate of growth, calculate the abundance of populations and ascertain the annual mortality of legal fish, as well as the catch.

The Approach to Greater Interest

Some people recently have suggested abandoning the exploratory phases of nature study, getting acquainted with wildlife, on the basis that proper conservation attitudes may be developed without identification and life history observations. The danger in eliminating these observations is that if students or fishermen do not distinguish between silver bass and largemouth bass or identify any of their life habits, an attitude about conservation will not benefit either species.

It has been rather well recognized that teachers who have a broad background of *experience in the out of doors*, field courses in *natural history*, *ecology*, *limnology* and *conservation*, seem to have much greater ability to inspire real conservation activity. They find the means of developing an interest in exploration which in turn will grow into genuine conservation attitudes.

Game fish are fairly well recognized by anyone who enjoys fishing. Interest in the habits of game fishes may be aroused through a discussion of environmental factors which serve as a key to the abundance of fish in local waters. Even among the proverbial fishermen, relatively few pause to examine the contents of a fish's stomach, which may serve as a clue not only as to its food habits but to the kind of bait to be used. Counting fish beds or eggs from gravid females may prompt some valuable questions on the problems of reproduction. Fish scales may be sent to specialists to learn the age of a fish and measurements may be kept to correlate age and size.

Few people, other than specialists, are able to identify the minnows. Because of their value as food to game fishes they are classed among the forage fishes. Little is known about the life histories of many of these small species. Instead of an aquarium of goldfish, little effort would be required to search local waters to establish an aquarium of local minnows. A minnow trap, seine or dip net, within legal regulations, could be utilized to good advantage.

Many of the requisites of fisheries

management could be learned through such an activity. A study of the oxygen relation, hydrogen-ion concentration, vegetation, temperature and food consumption would become a necessity for a successful aquarium. All these problems are involved in the present practices of skillful fisheries management. The interest in native small species should be no less than interest in the hobby of raising tropicals, a hobby which has become a sizeable business in many quarters. The benefits should prove more fruitful when related to local biology.

Pollution

The proper disposal of sewage constitutes a serious menace to public health and to good fish production. Pollution education usually lags behind most of the municipal and industrial waste disposal. As is true with most conservation problems, constant vigilance needs to be exercised and frequent arousal of public spirit is necessary to keep our local waters free from the damaging effects of pollution.

Damage to fish results from two general types of polluting agents.

1. The most common kind of pollution results from dumping into waters materials like domestic sewage, strawboard wastes, coal mine wastes, organic matter from milk plants or slaughter houses, canning plants, sugar refining plants, tanneries and paper mills. These by-products are decomposed by bacteria which bring about a depletion of dissolved oxygen. If large quantities of sewage enter streams from a city, the oxygen content may be completely dissipated and fish may be correspondingly absent for some distance down stream.

Water may become so putrid as to give rise to a problem in making it fit for drinking purposes where a stream supplies a community. The recreational value of such a stream is enormously affected as the stream becomes unfit for boating or swimming.

2. The second type of pollution develops from disposal of substances which are in themselves poisonous or detrimental. Examples are the acid wastes that come from plants making powder or galvanized wire, phenol waste which comes from plants using or producing coal tar, and cyanide wastes. Chemical plants, steel works, oil companies, saw mills, mine shafts and stone mills are but a few of the many types of industries responsible for dumping of poisonous wastes.

Pollution may be controlled by converting sewage into a less harmful form. Many municipalities have treated domestic sewage through modern sewage disposal plants which remove much of the organic material. Organic matter which is not thus removed is changed in form so that it is more quickly oxidized and lost in the stream. Even so, sewage effluent from large cities may reduce the oxygen content so that a stream may not support fish for some distance down stream.

On the other hand, if a sewage disposal plant functions adequately, the sewage may increase the fish crop once it becomes oxidized sufficiently to permit fish to live. Sewage, under such conditions, may be considered a fertilizer.

Wastes which are directly toxic or of a chemical nature may seriously affect fish production in ways other than directly killing the fish. Such poisons may serve as barriers to fish migrations; may hinder spawning activities; or, may deplete the stock of fish by killing fish food.

Artificial Ponds and Lakes

In many places of suitable terrain, an inexpensive farm pond offers an excellent educational opportunity for stimulating an interest in conservation problems and fisheries production. Fish production in any state may obviously be enhanced by increasing water areas both large and small. Farm pond management offers the agricultural landowner a practical project which may become as captivating as the aquarium is to the classroom.

Briefly considered, the development of a program of farm pond management involves: (1) Selection of a favorable site which should be based upon the greatest possible benefit to the conservation interests of the farm, (2) Preparing the pond for the kind of fish to be desired, which includes

planting of water vegetation and vegetating the shore line to prevent silting, (3) Introduction of the number of species of fish which may be adequately supported, (4) Continued regulation and control of the quantity of fish, balanced in accordance with the available food supply, and (5) Fertilization to increase the food supply if natural food is insufficient.

In recent years many large artificial bodies of water have been established chiefly through public works programs. Such lakes have been built both for recreational use and utilitarian needs. Rugged terrain with streams flowing through valleys is best adapted for damming to create lakes of impounded waters. Increased fishing pressure will likely call for further increase in extending water areas by artificial means.

Improve Local Waters

The most profitable advantage to be gained from an educational program of stream and lake improvement is to analyze local conditions. County and state maps are usually available which help to visualize the number and kinds of water areas within a given locality. A visit along nearby stream banks and lake shores will present many obvious problems of conservation. Stream pollution is clearly apparent in odor as well as in its visible effects. Muddy streams and rivers at flood stage are evidence of a distinct need for reduction in stream flow.

Due to periodic floods and other causes, streams are often deficient in shelter and natural food. Various kinds of obstructions including log deflectors, floating covers, tree trunks, rocks and dams have been used to provide shelter. Such methods are useful in retarding stream flow and increasing natural food since such obstacles encourage the growth of plant life.

Various means for the improvement of lakes may also be suggested. It is possible to furnish increased shelter through the use of different type of log, stump and brush construction. Some lakes are deficient in suitable spawning areas as gravel beds for sunfish and bass. Spawning slabs have been made available for certain forage fishes as the bluntnosed and fat-headed minnows. Horizontal tiles or kegs have been used with some success by catfishes for spawning. Control of vegetation, planting it where needed, and removing it where it is overabundant needs to be considered in the work of lake improvement.

Many other remedial measures for local waters could be suggested. Until careful study is made, based upon the problems of fish production as previously discussed, it would be unwise to attempt improvement without the help of expert counsel. It is part of the function of an educational program to recognize existing circumstances and not blindly to institute corrective measures without having established proof as to their efficacy.

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Fruit and the Home Garden

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Everybody would like to grow fruit in his garden, but space and skill are often factors which cannot be met by individual gardeners. The kinds and quantities of fruits, therefore, which any person can cultivate on his own property must be selected with reference to the conditions which prevail. For example, if a person is working a garden with a community group and has the space for only one season, he cannot grow any of the plants which we generally classify in this country as fruits.

The ability to grow fruit in one-season gardens, fortunately, is not limited by definitions, for we have several annual fruits which are classified as vegetables that are available to one-season gardeners. These include tomatoes, muskmelons and watermelons. Everyone of these vegetable fruits possesses high vitamin contents; all three of them are palatable; all three fit into salad uses, and watermelons and muskmelons are among the most delightful of all fruits for dessert purposes.

Dr. Wm. Butler once said, "Doubtless God could have made a better berry than the strawberry, but doubtless God never did." The strawberry is the one fruit which almost every gardener who has a fairly permanent location or owns his own plot of ground, can grow in some quantity and with some satisfaction. The strawberry can be grown from the Arctic Circle to the Gulf of Mexico and in every state from the Atlantic to the Pacific wherever local conditions of soil and moisture are reasonably favorable. A patch of 200 square feet will supply a family of four with fresh strawberries for at least six or eight meals. Often it does much better than this, leaving a small surplus for strawberry jam. The big trick in strawberry growing is to renew the patch every two years.

Next to the strawberry, the grape is the most widely adapted of all our fruits and will give satisfactory results in more gardens than any of the others. It is more restricted in its climatic adaptation than the strawberry, but nevertheless it makes a good garden fruit in many localities in nearly all of the states. On account of the fact that it is grown on a trellis, it does not take up too much space for small gardens. It is good along the boundary fences. It fits an arbor. Sometimes it is even used as a house wall decoration. The grape is long lived and begins to bear good crops of fruit the third year after planting.

Sprouts from the roots of the original Concord vine, which must have been a seedling about 1845, still cover a trellis beside the old Ephraim Bull cottage in Concord, Mass. The roots of this vine must be almost 100 years old at this time.

Less widely adapted from the standpoint of soil and climate, but very satisfactory for home gardens because of the small size of the plants are raspberries, blackberries, currants and gooseberries. All of these will begin producing in the second year after planting and will become increasingly productive during the next two years. They are not as long lived as grapes, though gooseberries and currants will continue in fairly good production for periods ranging from 8 to 15 years.

One nice thing about the bush and bramble fruits is the fact that they grow well under mulch. People living in town can often gather large quantities of leaves in the fall from their own or neighboring lawns and simply pile them thickly underneath these fruits. A foot or two of loose leaves can be added every fall and a very effective mulch gradually be accumulated around the plants.

In recent years people have come to enjoy the trailing types of blackberries and dewberries and the numerous hybrids which have appeared in this group of fruits. Among the new varieties in this classification are the Loganberry, the Youngberry and the Boysenberry. All of them make excellent juices and are very popular for pies; many people enjoy them fresh. These berries should be regarded as semi-hardy. Moderate protection is enough to bring them through the winter successfully in regions where raspberries and blackberries are hardy. They should be grown on trellises, however, and each year most of the old wood should be cut away, leaving only strong new canes to bear the crop.

The fruits which the gardener covets most to grow are the tree fruits. These are the most difficult for him to possess because they require space which he may not have, time for development and degrees of skill in management which only an expert can hope to master fully. The difficulties in the growing of tree fruits in home gardens, however, should not stand in the way of the gardener who has sufficient space and interest to undertake their cultivation. Even if every apple on the 3 trees in my own backyard had been wormy this year, and too many of them were, I would still have gotten so much pleasure and satisfaction from having them that they would have been worth the while.

I hope the time is not far distant when we shall be able to grow a good many desirable varieties of apples on bush-like trees which do not take too much room for town gardens, but we do not now have the combination of skill, suitable understocks and varieties to promise success to every home grower who undertakes to grow dwarf apple trees in his backyard. This is a field into which the gardener should venture for fun rather than with a definite assurance of good returns, but the pleasure of adventure in fruit gardening is sufficiently alluring that many should undertake it.

The other leading tree fruits, aside from those in the citrus-growing areas, are peaches, pears, plums and cherries. Where climate permits the peach is the easiest of these to grow. In more severe climates, where peaches cannot be grown, there may easily be cultivated a great selection of plums, the varieties being chosen with reference to locality.

Most amateurs would love to grow pears. I think this is the trickiest of all our tree fruits to grow, and all because of the fact that the pear is subject to a deadly disease called fire blight. There is no first class variety of pears which is immune to fire blight. If the gardener lives in the Great Lakes area or the northeast Atlantic coast he should include this most luscious of the tree fruits in his collection.

Perhaps the most difficult problem to solve in the growing of fruits at home is the control of insect and fungous pests. This problem is on the way to a satisfactory solution. I think there is reason to believe that by the time fruit trees which are planted during the next four or five years come into bearing, simplified machinery for applying insecticides and fungicides will have been developed and more effective chemicals for the control of fruit pests will be on the market. Even with the present control measures

many people can count on sufficiently effective controls to give them large quantities of satisfactory fruit. As a matter of fact, it is not necessary in large home gardens and farm orchards to have 100% perfect fruit.

Next, in hindrances to growing fruit trees successfully at home, must be listed a combination of neglect and ignorance of methods of planting and growing the plants. More apple trees are killed by common field mice which girdle the trunks at the ground, and by rabbits which eat and tear the bark on the trunks, than by any other single cause. Yet the damage from both of these is easily prevented in home orchards by wrapping the trunks with paper while the trees are young, or with hardware cloth which will last for several years when once it is applied. Permitting weeds to overgrow young trees or grass to compete too vigorously with the roots of the trees, neglect of pruning and other failures in cultural methods account for many casualties and for the slowness with which fruit trees often come into bearing.

Home owners on farms and sizable town lots should grow fruits. They need them because of frequent shortages, particularly at this time. They need them on the farm because farm families will not have enough unless they grow them at home, no matter how plantiful they are in the markets. Finally, all who grow fruits derive a satisfaction and pleasure from doing so, which is worth as much to many as the nutritive value of the fruit itself.

NEW YORK ASSOCIATION OF BIOLOGY TEACHERS

Probably all teachers are interested in their own health and in the well being of their pupils. Towards this end, *The New York Association of Biology Teachers* has scheduled a series of five lecture-demonstrations on those diseases whose cause, prevention and cure should be common knowledge. Four of the diseases to be considered are responsible for most of the deaths in our environment. Some of these diseases affect the upper age groups mainly but some of the symptoms appear early—even in youngsters of elementary and high school age. All of the lecture-demonstrations are given by eminent practicing specialists and there is opportunity for questioning.

The 1943–4 program is as follows:

Oct. 2.—*The Problem of Cancer*
Dr. Halsey Bagg

Nov. 5.—*The Problem of Syphilis*
Dr. William Bayard Long

Dec. 3.—*The Problem of Tuberculosis*
Dr. Grant Thorburn

Mar. 3.—*The Problem of Emotional Disturbances of Youth*
Dr. Marion Kenworthy

May 5.—*The Problem of Certain Diseases of the Circulatory System*
Dr. William Goldring

All of the lecture-demonstrations are at the American Museum of Natural History, Fridays, at 8:00 P.M., Room 319.

Paul F. Brandwein,
Forest Hills High School,
Chairman Program Committee

BIOLOGY TEACHERS CLUB OF SOUTHWESTERN PENNSYLVANIA

Subject: *Tropical Diseases*—Their Relationship to the Armed Forces and Post-war Health in the United States.

Speaker: *Dr. J. Franklin Karcher,* Medical Lecturer, University of Pittsburgh.

This meeting was held Monday, January 10, 1944, at the Frick Training School, Pittsburgh, Pennsylvania. Dinner and an Executive Committee Meeting preceded the program.

"The Club extends hearty thanks to Dr. Edward V. Claus for arranging the fine trip to the Bacteriological Laboratories of the city of Pittsburgh housed in the Municipal Hospital. Dr. Eisaman's courtesy explanations and demonstrations made the December meeting a memorable one."

A SHOW-CASE DISPLAY

Oxidation as a central idea for a show-case display attracted the interest of students and patrons of our school.

Three one-gallon glass jars, purchased at ten cents each, were used for microcosms. One contained sand, snails, and algae from a near-by creek, together with a half gallon of water and a tiny gold fish. It was sealed shut and labeled: *Plants release oxygen, used by fish in oxidizing food.* (A duplicate microcosm was placed in sunlight and alternated with the one in the show case every noon. This was to insure satisfactory results even though artificial lighting was used in the case.)

Another microcosm was kept in the show case which was the same as its counterpart except that the algae were omitted. It was labeled: *No plants—no oxygen! The fish will not live!*

A coleus cutting with an extensive root system, developed in water, was marked: *Growth—a result of the oxidation of food in plants.*

A small collection of igneous rocks was labeled: *Fire-made rocks—a result of rapid oxidation.*

A slice of a cork, covered with iron filings, was placed in a Petri dish filled with water. It was labeled: *Rusting—a slow form of oxidation.*

Appropriate drawings were labeled: *An explosion—a rapid form of oxidation,* and a camp fire, *oxidation of wood.*

ROBERT C. MCCAFFERTY,
Central Junior High School,
Newark, Ohio

Reviews

TEXTBOOKS

BENEDICT, RALPH C., KNOX, WARREN W., AND STONE, GEORGE K. *Life Science—A Biology.* Macmillan, New York. 682 pp. 1941. $1.65.

Literary Style: The authors have given us a biology which depends on the inherent interest of biological topics. The title, "Life Science—A Biology," although correct, seems not to have any special appeal to biology students. Facts are told in a style simple and direct, unembellished with startling phraseology intended to capture the presumably lagging attention of the student. They have stated in the introduction: "The motivation is not spectacular but rational, the facts of biology are relied upon to provide adequate motivation." An examination of the text shows they have pursued this course with success. Perhaps this has brought with it a slight stiffness and a formal quality to the style. This might have been excluded by a more frequent appeal to the pupil's knowledge and experience.

Sentences are clearly constructed and concise. One is never in doubt about the meaning intended. Ideas are developed in a very orderly way. The choice of words appears well within the age-group for which the book is written. Technical words are defined in the text or in the glossary.

Subject Matter: This book contains a wealth of biology and each unit suggests many opportunities for student activity, while the review and thought questions certainly imply a definite knowledge of the material presented. Specifically in unit six, we find the question "What evidence is there that even a one-celled animal may learn from experience?" As an activity the student may observe the defense mechanism of the paramecium by adding blue fountain pen ink to the culture. To understand both of these problems, one must have a good conception of the cell as a living structure.

Social implications have never been lost sight of. On page 45 we find castor oil, digitalis and camphor obtained from useful plants but that marijuana, morphine and

nicotine also are plant products that may make us sick. These teach one what to preserve and on the other hand what to check. The factual material used is accurate but in proofreading several errors went by unnoticed. On page 338, Pickiwill, G. B., should be Pickwell, and on page 554, Schreinfeld, Amram, should be Scheinfeld.

There is so much that might be included in a Biology text that many parts must be omitted but I should like to see some first aid included. The correlations of textual material are most evident throughout the book. This is one of the outstanding virtues of the book. First the biological facts are presented, then these are followed by the practical applications.

Psychological Soundness: There is little evidence of a conscious artistic typography. The organization of material is that of most textbooks these days, based on function with applications throughout the living world, including man. The material is very simply presented, making the text suitable for use for the less able pupil. It is not based on any particular environmental factors, which makes its use practical anywhere. The correlation with other subjects is very good and this feature is worth nothing in these days when all teachers are seeking to make education an integrated part of the child's life. The vocabulary is simple and adjusted to the capacities of the average pupil. The disadvantages of the book are the lack of material calling for the use of scientific methods of thinking. The suggested reading lists appended to each unit might offer some answer to this difficulty, but the average school child has not the time for, nor will he do, a great deal of supplementary reading.

Learning Exercises and Teacher's Helps: Titles of 200 laboratory exercises are given in the appendix. But no plans for the exercises are included. The text is organized around nine major units with two to five subdivisions under each unit. A list of review and thought questions and suggested activities is included at the end of each sub-division.

One finds no testing devices included and references for pupil and teachers are included at the end of each unit. An eighteen-page pronouncing glossary of biological terms is a welcome feature of this book, almost unique in biology texts. The index, consisting of 34 pages, is very complete. The table of contents is brief, giving only the unit titles and headings of sub-divisions.

ALAN A. NATHANS, (Chairman) New York
ANNE L. BIGLER, California
IRENE KERSTETTER, New Jersey
T. R. STEMEN, Oklahoma
FRANKLIN B. MYERS, New Jersey

ANDERSON, ARTHUR L. *Introductory Animal Husbandry.* Macmillan, New York. x + 777 pp. illus. 1943. $4.00.

This book is intended for beginning students on the college level, but it is so well outlined with paragraph breaks and subheadings, so fully illustrated and so clearly written that it can be read with profit by the more interested high school students also. At the same time it is comprehensive enough to be a valuable reference work for the general agriculture teacher or the biology teacher who likes to make frequent applications to agriculture. There are 45 chapters: an introductory chapter on livestock in agriculture, 19 on cattle (divided into two sections, A. Beef Cattle, and B. Dairy and Dual Purpose Cattle), 8 on swine, 8 on sheep and 9 on horses and mules. There are more than 300 figures, most of them photographic, and all of them far above average in quality. Dozens of tabular summaries, scattered throughout the book, greatly increase the amount of material per page. Some of these are especially interesting and valuable for student references, as for example, the one on the by-products of hog slaughter. This includes brushes, felting, rug pads, insulation, razor strops, salves, cosmetics, candle stock, soap, etc., as well as the actual meat products. The classified list of references is comprehensive enough to fit in with the rest of the book. The 19-page index is organized in detailed form, with many cross references. This, together with the form of organization of the body of the text, makes it unusually easy to locate any specific item.

JOHN BREUKELMAN

MANUALS

EMIG, W. H. *Stain Technique.* Science Press Printing Co., Lancaster, Pa., 75 pp. 1941. $1.00.

The chapter headings are as follows: *Dyes First Used, Chemical and Physical Properties of Dyes, General Uses of Biological Stains, Staining with Contrast Dyes, Biological Stains;* the last named, including over 50 of the total pages, is excellently organized, with synonyms and formulas in abundance. The type is easy to read; the spiral back allows the book to lie open at any page; the binding is of tough black paper. The little book should prove highly valuable to anyone interested in microtechnique, amateur and professional alike.

LAZEAR, E. L. *Anatomy of the Dogfish.* Stanford University Press, Stanford University, Calif., vi + 113 pp. illus. 1943. $1.25.

A descriptive manual, beginning with preliminary instructions and a discussion of the

basic plan of the body and then describing each system in detail. Considerable emphasis on variations, development, and the language of anatomy. The illustrations are very helpful in clearing some of the points ordinarily most difficult for students, *e.g.*, the muscles of the gill region. The table of cranial nerves includes superficial origins, ganglia, branches, functional components, foramens, somites, distributions and miscellaneous notes. There is no index.

MOVIES AND SLIDEFILMS

The teacher shortage, due to wartime conditions and demands, brings one of the serious problems with which vocational and classroom education is face to face. To supplement the existing training programs, there has been produced, in cooperation with the Navy, a visualized course in the fundamental techniques of teaching. The Jam Handy Organization, 2900 E. Grand Boulevard, Detroit, Michigan, now a war film production agency, has undertaken to distribute the films to interested schools.

Some of the films are having widespread use in the Armed Services as a means of preparing instructors most effectually and most thoroughly to convey their learning and information to others. The program is supplementary to other accepted mediums commonly used in our teachers colleges.

The series comprises a sound motion picture, *Tips for Teachers*, about 19 minutes in length, supplementary to nine slidefilms, each with a sound-on-disc record. These slidefilms may be used without the discs, in the latter case providing the basis for instructor discussion and class participation. Another supplementary feature is a sound motion picture, *Giving a Shop Demonstration*, the purpose of which is to help improve teaching technique in the school workshop. In many instances these subjects are being used as "refresher" material, in others as a speedup method of giving the embryo teacher a general understanding of approved classroom and workshop techniques.

An outline of the contents of this series will give a good idea of the character and purpose of the material:

THE TEACHER: Personal characteristics, appearance, bearing, habits, gestures, speech, attitude—45 pictures.

SOME PRINCIPALS OF TEACHING: Seven suggestions on how the teacher can shorten the learning process—46 pictures.

I WANT TO LEARN: How course information is grooved in—50 pictures.

THE LESSON PLAN: Place and value of planned lessons in motivation, student participation and assignment—47 pictures.

MAKE YOUR CHALK TALK: Talking to the eye of the student with chalk, notes on blackboard drawing, and free hand sketching—68 pictures.

TEACHING A VOCATION: Learning through doing, and basic safety precautions—the "carry over"—49 pictures.

SHOP TEACHING: Formal preparation of shop lessons, and how to demonstrate—35 pictures.

DESIGNING EXAMINATIONS—PART 1: Value of examinations, and a discussion of the essay type—35 pictures.

DESIGNING EXAMINATIONS—PART 2: Continuation of discussion on examinations with emphasis on objective type tests—15 pictures.

The motion picture, *Tips For Teachers*, presents on the screen the "P's"of good teaching, explains the place and value of the teacher's *personality*, dramatizes the importance of *preparation*, gives examples of how the *presentation* of material is best accomplished, and shows how the teacher can effectively use showmanship, etc., to help shorten the learning process.

The substance of the motion picture, *Giving A Shop Demonstration*, is to show how properly to assemble tools, materials and equipment, and how to conduct practice work by the class in the school shop.

LYNE S. METCALFE,
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NATURAL HISTORY LEADERSHIP TRAINING

The State Teachers College, Indiana, Pennsylvania, announces a pre-session summer course in out-door biology, designed to meet the demand for nature counsellors in summer camps, Victory Garden directors, etc. It is a three-credit course, which may serve as an elective or contribute toward a major or minor in biological science.

The following activities are included:

1. Caring for a garden.
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3. Construction of a camp museum.
4. Identification of the common plants and animals.
5. At least one overnight trip. Bedding to be furnished by the student.
6. Planning of menus and preparation of food for short field trips.
7. Study of problems of food and shelter, using materials from the environment.

For further information, address *The Registrar, State Teachers College, Indiana, Pa.*

PLANT GROWTH DUE TO HORMONES OR HORMONE-LIKE SUBSTANCES

Hormones or similar substances are known to influence growth, either causing it or inhibiting it. A knowledge of these aids to growth is of practical value to the plant grower as well as the botanist.

In my work with Dr. C. D. LaRue at the University of Michigan Biological Station at Douglas Lake, Cheboygan, Michigan, I used several methods to promote growth. Most of this work was on root or rhizoid growth although local applications caused curvature of stem or petiole as the side having the application grew more rapidly than the opposite side.

Briefly the methods are:

1. Application of 1% to 3% indole 3 acetic acid in lanolin or 1% to 3% indole butyric acid in lanolin to:
   a. Stems and petioles of tomato plants.
      Result: curvature.
   b. Stems and cotyledons of castor bean, Kentucky Wonder bean, sunflower, tomato and balsam.
      Result: adventitious roots.
   c. Mosses.
      Result: rhizoid growth.
2. Wounding of herbaceous plants causing wound hormones which produced roots. Wounding was produced by slicing lengthwise with a razor blade.
   a. Leaves of *Coleus blumei* sliced at petiole. Wounded part removed after two days. Part removed from controls also.
      Result: root growth.
   b. Stems of *Mentha arvensis americana*, *Lysimachia nummularis* and *Sedum purpureum*.
      Result: root growth.
   c. Mosses.
      Result: rhizoid growth.
3. Application, on woody cuttings, of plant extracts from plants possessing considerable regenerative powers.
   a. Cuttings of willow and poplar in extract of *Radicula aquatica* for two days and then in water.
      Result: more rapid rate of root growth.

Commercial products are now sold which stimulate root formation giving a higher percentage of success in plant propagation.

This experimental field of plant growth is well worth the attention of the botanists. In actual work or for a fuller knowledge of what leading botanists have done, the following references will be helpful.

LaRue, C. D., The Effects of Wounding and Wound Hormones on Root Formations, *Proc. Nat. Acad. Sci.*, Vol. 27, No. 8, pp. 388–392. 1941.

LaRue, C. D., *Papers Mich. Acad. Sci. Arts and Let.*, Vol. 22, pp. 123–139. 1936.

LaRue, C. D., The effect of wounding, of wound hormones, and of growth hormones on rhizoid formation in mosses and liverworts, *The Bryologist*, Vol. 45, pp. 35–39. 1942.

Bonner, J., Plant Tissue Cultures from a Hormone Point of View, *Nat. Acad. Sci.*, pp. 426. 1936.

Warner, C. C., and Went, F. W., Rootings of Cuttings and Indole Acetic Acid and Vitamin B, *Plant Culture Publishing Co.*, Pasadena, California, pp. 1–12. 1939.

Mitchell, J. W., Plant Growth Regulators, *U. S. Dept. Agric. Bureau of Plant Industry* Misc. Bulletin No. 495.

Jeannette Duer Sheridan,
1743 North Meade Avenue,
Chicago, Illinois

The committee on local and state organizations is anxious to hear from each and every listed affiliate. The work of this committee will be constructive in proportion to the information they receive from the local organizations. The chairman is Prevo L. Whitaker, *University High School, Bloomington, Indiana.* He writes that the committee is working on a data sheet, to be sent to each local, on which reports may be sent in with a minimum of time and labor.

Next month: the fourth unit in the Conservation series, another garden article, a list of garden books, election results, index to Volume VI, etc. Send in your renewal now for *Volume Seven.*

(*Continued from page 152*)

may also be tried to supplement the treatment with other chemicals. In general Vitamin B is used for vigorous growth, especially on house plants. Ordinary Vitamin B complex tablets such as are sold for human consumption, if dissolved and used in watering house plants, particularly philodendrons and ivies, will give excellent results. A tablet may occasionally be placed in a five-gallon aquarium. A very small quantity of commercial yeast will also stimulate the growth of aquarium plants, although the unicellular green algae may profit too thoroughly.

Sometimes plant experimenters think that growth-promoting substances will replace proper light, temperature, and soil, but they will not, any more than vitamin tablets will replace beefsteak and onions on the dinner tables of humans. However, given all the proper conditions possible, there is every reason to believe that good results should follow from the use of growth stimulants.

Plant chemicals are not labor-saving devices, nor are they panaceas for horticultural ills. One must understand them very well before rushing into attempts to apply them practically on a large scale.

BIOLOGY NOTES

"A WATERPROOF CIGARETTE paper that sheds water has been developed by Stephano Brothers. The treated paper is tasteless and odorless and able to withstand any climatic condition. At present the entire production is reserved for service men and women."—Pathfinder.

BRAZILIAN COFFEE. Coffee exports dropped heavily last year due to submarine warfare off the shores of Brazil, Merchant Marine losses, and withdrawal of North American vessels from the South American line. However, satisfactory prices received for the coffee exported compensated for it according to official announcement.

NOISE KILLER. "When Joshua fought the battle of Jericho and the walls of the city came tumbling down, the laws of vibration were in full swing. Vibration is one of the most destructive forces to be reckoned with. The field of aviation is no exception. Plane structures and flyers are victims of it. Until recently the only known effective vibration dampener for airplanes was mica, a strategic material obtained largely from India. Faced with a complete shut-off of this import, scientists began extensive studies to find a substitute. The U. S. Rubber Co. recently announced the discovery of a new insulation compound, called Vibeston. Made from asbestos and other non-strategic materials, Vibeston is 50% lighter than mica, which makes possible the insulation of larger areas of planes without increasing the weight. Aside from prolonging the life of the equipment by reducing the vibration, it also protects the flyer's ears."—Pathfinder.

PAPER LICENSE PLATES. "New white rags converted into paper or cardboard may become the license plates for America's autos. In a grueling test covering 30,000 miles of auto travel through eleven western states, experimental cardboard plates came through undamaged."

NO MORE GUINEA PIGS. Two laboratory technicians, Mrs. Lois Gallaher and Pauline Kurachi, from Colorado State Hospital have found a way to substitute hen's eggs for the traditional guinea pig as the testing medium for research in tuberculosis and other infectious diseases.—Pathfinder.

WARBLERS. April is the month of the warblers. Over 40 species of them visit the United States; according to Chapman, "they are at once the delight and despair of field students. To the uninitiated, their existence is unknown, and when search reveals the before unsuspected fact that our woods are thronged with birds as exquisitely colored as the daintiest tropical forms, we feel as though a new world were opened to us."

FIELD'S GOLDEN. The Mammoth Field Museum of Chicago is 50 years old. In 1894 the name of the museum was changed from Columbian Museum of Chicago to its present name. It was to recognize the benefactions of Marshall Field, the department store executive. Upon the death of Mr. Field, the museum was given $8 000,000 with the stipulation that half the sum be used to erect a new building.

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